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NIGHT VISION GOGGLE TRAINING: DEVELOPMENT AND PRODUCTION OF SIX VIDEO PROGRAMS

DeForest Q. Joralmon
Joseph C. Antonio

University of Dayton Research Institute
300 College Park Avenue
Dayton, OH 45469

HUMAN RESOURCES DIRECTORATE
AIRCREW TRAINING RESEARCH DIVISION
Williams Air Force Base, AZ 85240-6457

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Patricia A. Spears
PATRICIA A. SPEARS
Contract Monitor

Dee H. Andrews
DEE H. ANDREWS, Technical Director
Aircrew Training Research Division

Lynn Harold
LYNN A. CARROLL, Colonel, USAF
Chief, Aircrew Training Research Division

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DeForest Q. Joralmon
Joseph C. Antonio

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300 College Park Avenue
Dayton, OH 45469

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This report contains a paper submitted to the 14th Interservice/Industry Training Systems Conference held 2-5 November 1992 in San Antonio, TX. With the increased use of night vision goggles (NVG) within the US Air Force, Navy, and Marine aviation communities, there is an expanded need for NVG training. The paper describes the role of NVG training videos within the prototype NVG training course, the content of the presentations, and techniques used in the production of the programs. It concludes that video presentations showing examples of NVG imagery can successfully be used to augment NVG training.

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PREFACE

This work was conducted at the Armstrong Laboratory, Aircrew Training Research Division (AL/HRA) at Williams Air Force Base, AZ, by the University of Dayton Research Institute (UDRI). AL/HRA conducts visual training effectiveness research in support of aircrew training technology. One entity of this effort is a night vision training research program.

UDRI, working under Contract F33615-90-C-0005, is developing prototype instructional media and courseware to be used in aircrew night vision goggle (NVG) training. This report contains a paper submitted to the 14th Interservice/Industry Training Systems Conference held on 2-5 November 1992 in San Antonio, TX, which describes the role of the NVG training videos within the prototype NVG training course, the content of the presentations, and techniques used in the production of the programs. The laboratory contract monitor was Ms. Patricia A. Spears. This effort was managed under Work Unit 1123-03-85, Flying Training Research Support.

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DeForest Q. Joralmon
University of Dayton Research Institute
Dayton, Ohio

Joseph C. Antonio
University of Dayton Research Institute
Dayton, Ohio

ABSTRACT

With the increased use of night vision goggles (NVGs) within the Air Force, Navy, and Marine aviation communities, there is an expanded need for NVG training. Six video programs have been produced covering the following subjects: image characteristics, luminance variations, lighting issues, terrain albedos, weather effects, and navigational issues. These linear presentations demonstrate a variety of NVG attributes, limitations, and operational capabilities. Intensified imagery acquired from both airborne aircraft and ground-based locations provide visual examples of the concepts discussed. The programs are generic in that they apply to both rotary and fixed-wing flying communities. The programs are used to augment ground school and may be used as refresher training prior to NVG flying. This paper describes the role of the NVG training videos within the prototype NVG training course, the content of the presentations, and techniques used in the production of the programs. These six video programs form the basis of an NVG interactive videodisc currently being developed.

ABOUT THE AUTHORS

DeForest Q. Joralmon earned his B.S. degree in Telecommunications from Northern Arizona University and a Master of Mass Communication degree from Arizona State University. His applied research interests include the study of electronic media and concentrate on the development of interactive videodiscs and multimedia projects. Mr. Joralmon is currently a producer for the University of Dayton Research Institute (UDRI) working at the Aircrew Training Research Division of the Armstrong Laboratory, Williams AFB, Arizona.

Joseph C. Antonio obtained a B.S. degree in Industrial Management from the Georgia Institute of Technology, a B.S. degree in Chemistry from Armstrong State College, and a Doctor of Medicine degree from the Medical University of South Carolina. He has over 4000 hours of military and civilian flying experience including combat and instructor time. His research interests include aircrew training, aerospace medicine, and human factors. Dr. Antonio is presently a research physician scientist for the University of Dayton Research Institute working at the Aircrew Training Research Division of the Armstrong Laboratory, Williams AFB, Arizona.

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DeForest Q. Joralmon
University of Dayton Research Institute
Dayton, Ohio

Joseph C. Antonio
University of Dayton Research Institute
Dayton, Ohio

INTRODUCTION

The Aircrew Training Research Division of the Armstrong Laboratory (AL/HRA), located at Williams Air Force Base in Arizona, conducts visual training effectiveness research in support of aircrew training technology. One entity of this effort is a night vision training research program. The increased use of night vision goggles (NVGs) by the Air Force, Navy, and Marine aviation community has expanded the need for NVG training. Units currently using NVGs have expressed a need for improved NVG training programs. The University of Dayton Research Institute (UDRI), working under contract to AL/HRA, is developing prototype instructional media and courseware to be used in aircrew NVG training.

PROTOTYPE COURSE AND FACILITIES

The NVG training course under development is designed primarily as initial training and secondarily as refresher training for NVG aircrew, life support, and aeromedical personnel. The major sections of the course are as follows:

1) Introduction and Visual Physiology
2) Circadian Rhythm, Fatigue, and Spatial Disorientation
3) The Night Environment and Night Vision Devices
4) Cockpit Procedures and Lighting
5) Specific Techniques and Lessons Learned
6) Hazards and Emergency Procedures
7) NVG Fitting and Life Support Training
8) Simulator or Static Cockpit

The prototype course is taught in facilities designed specifically for NVG training. The facilities consist of a lecture room equipped with slide projection and video playback capabilities, a terrain board, a test lane used for NVG adjustment and assessment, a cockpit lighting demonstrator, and an instructor's office. The USAF currently has two such facilities in place at Williams AFB, AZ, and at Kirtland AFB, NM. Three other facilities are planned for Ellsworth AFB, SD; Pope AFB, NC; and Hurlburt Field, FL. In support of the NVG prototype training course, six video programs were produced for use at appropriate times during the instruction.

NIGHT VISION GOGGLE TRAINING VIDEO PROGRAMS

The subjects for the six video programs were chosen based on current and historical information supplied by test and operational personnel actually involved in NVG employment. Operators from all three services were used as subject matter experts in helping to define program content. Additionally, representatives from the training communities were used in determining how to integrate the video presentations into the various current night vision curricula in order to maximize their effectiveness. The titles of the six video programs are listed below:

1) NVG Image Characteristics
2) Luminance Variations
3) Lighting Issues
4) Terrain Albedos
5) Weather Effects
6) Navigational Issues

The program on image characteristics demonstrates NVG field of view, field of regard, scan techniques, image resolution, and intensified image peculiarities. The program on luminance variations demonstrates how various night luminance conditions, such as moon angle and phase, impact NVG image quality and operational employment. The program on lighting issues demonstrates the effects cockpit lighting, external lighting, cultural lighting, and ordnance use have on NVGs. The program on terrain albedos shows how various terrains appear through NVGs and how that appearance affects NVG employment in an aviation environment. The program on weather effects presents information on how environmental conditions, such as rain or blowing dust, impact NVG performance. The program on navigational issues demonstrates how NVGs can enhance navigational capability and increase situational awareness during nighttime missions.

Production Treatment

The term production treatment refers to the style in which a program will be presented to the audience. In the case of these six NVG training presentations, several strategies were adhered to during the production process. The programs are designed to be generic in that they apply to both rotary-wing and fixed-wing aircraft. When a subject being discussed is aircraft-type specific, it is clearly stated as such. The presentations are designed to augment NVG training and are not used as stand-alone instruction devices. An instructor will discuss or lecture on a certain subject and then show the appropriate videotape to aurally and visually demonstrate key points. Secondarily, the programs can be used for refresher training prior to NVG flying or as a reference tool on the squadron or wing level. The programs run approximately ten minutes each. This run time was decided upon to minimize any loss of attention during program presentation. Finally, NVG users and subject matter experts were used as talent. Each program has a different narrator who appears on-screen at the beginning and end of each program. The idea is that the viewers will identify with presenters who have NVG experience and thus more credibility is lent to the programs.

Production Techniques

One of the first and most important steps in producing the NVG training video programs was writing the scripts. Once the scripts were written, all the various shots required were described and listed in detail.

The unique aspect of producing these programs was the need to record intensified images onto videotape. The systems used to acquire such video as well as some post production techniques are described below.

Intensified Image Videotape Acquisition Systems - A system for videotape acquisition of intensified imagery requires five basic elements: An image intensifier with an objective lens, a video camera, a viewfinder or a monitor, a device for coupling the intensifier to the camera, and a videotape recorder. Three configurations of videotape acquisition systems were used in the production of the NVG training video programs. The components of these configurations are shown in Figure 1.

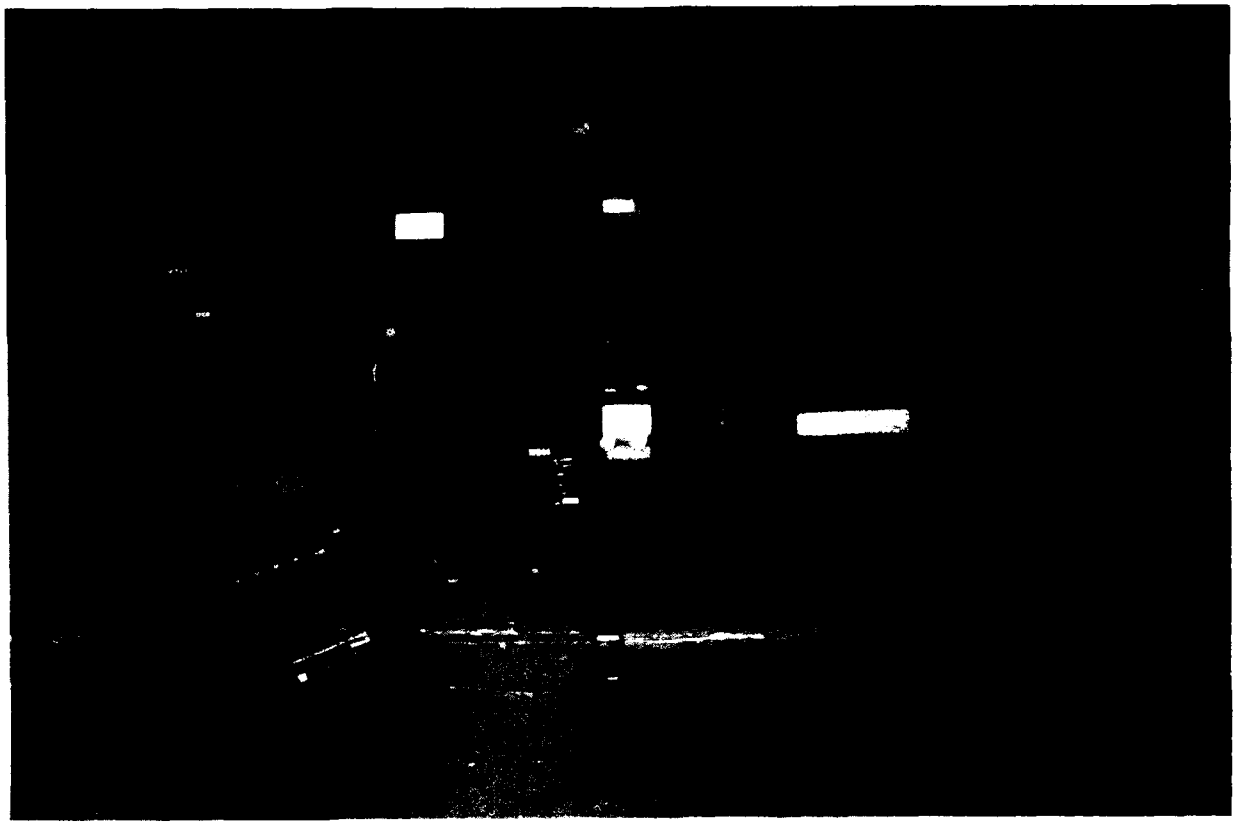

Figure 1. Intensified image videotape acquisition systems used by AL/HRA.

The first system uses a Sony EVC-X10 8mm camcorder. A Litton 944 Gen III pocketscope with a 27mm objective lens is used for image intensification. The Sony camcorder has a C-mount lens which allows for direct coupling to the image intensifier using a Litton 2/3" relay adapter.

A second system is configured using a Sony CCD-V701 Hi8 camcorder. The main physical difference between this and

the first system is that an aluminum adapter sleeve is used to couple the image intensifier to the camcorder. This system has a wider field of view than the first system. However, vignetting is present on the television monitor and the image appears in a circle wipe effect.

The third system configuration uses a Cohu 4810 high resolution, high sensitivity monochrome camera with a C-mount lens. The image intensifier and coupling device are the same as in the first system. This system requires a separate video recorder and monitoring device.

The advantages of these video acquisition systems are that they are lightweight, portable, compact, and have the ability to record up to two hours on a single videotape. The main disadvantage is the decreased image resolution when compared to viewing the intensified image with one's eye through an eyepiece. Two other disadvantages are the lack of unaided peripheral vision that an NVG user has and image instability as a result of shooting scenes by hand during flight.

The two systems based on camcorders are best suited for handheld aerial videography. The systems are self-contained and relatively easy to use in the dark and while moving around within an aircraft. The Cohu 4810 camera works well in both ground-based applications and low luminance conditions. Any of the systems could also be hard-mounted on an aircraft and record a fixed point of view. Two photographs obtained from videotape recorded using these cameras are shown in Figures 2 and 3.

The resolution of videotaped night vision can possibly be improved by using a fiber optic minifier that is adhered to the back of the image intensifier and to the front of the camera's charged coupling device (CCD). This eliminates the glass relay optics currently being used in AL/HRA video acquisition systems. Unwanted camera movements, such as those produced by aircraft vibration, can be minimized by using a stabilized lens. To date, AL/HRA has not tested either of these ideas for improving image quality.

Post Production - Post production is the process in which all graphics, video, and audio elements of the program are edited together into the final presentation. This work was performed at the Research Communications Center (RCC) video production facility located at AL/HRA. Computer animation, digital video effects, and electronic character generation were used to help demonstrate principles discussed in the programs.

Program Distribution

The six programs were duplicated and packaged in box sets that included each program on a separate videotape as well as another videotape with all six programs recorded thereon. The box sets were distributed to NVG training officers on both the wing and squadron level throughout the USAF, USN, and USMC. The distribution lists were based on sponsor-generated input. Approximately eighty sets had been sent out as of 31 May 1992.

CONTINUING DEVELOPMENT OF NVG TRAINING VIDEO PROGRAMS

Further development and production of instructional media for night vision device training continue. Several projects mandate the creation of both linear and non-linear or

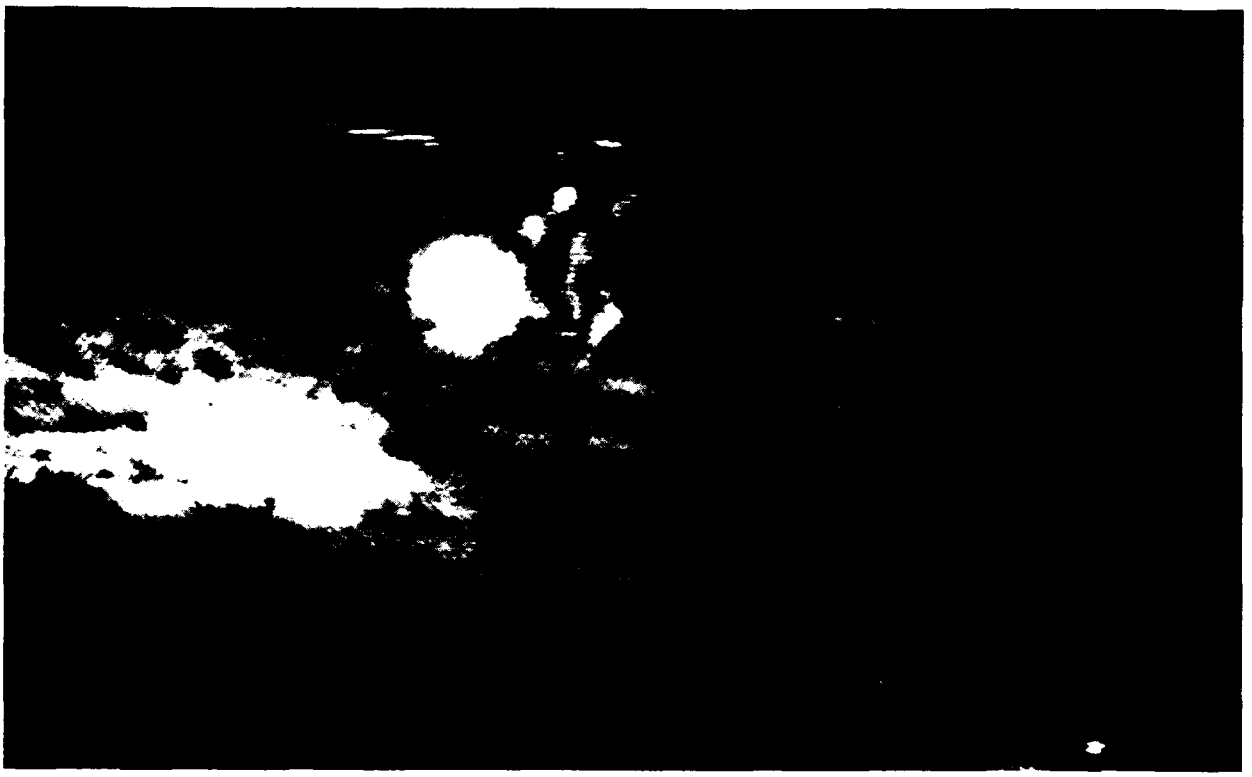

Figure 2. Night vision video of rising terrain in southern California.

Figure 3. Night vision video of an HH-3 helicopter operating in southern Arizona.

interactive video programs. Strategies and methods for generating viewer feedback on the effectiveness of such programs are also being developed.

Aircraft and Mission-Specific Presentations

As a follow-on to the generic nature of the first NVG training programs, presentations that specifically address certain aircraft and missions are being produced. These products will concentrate on how NVGs are employed by various crew positions (if applicable) and how they integrate into mission scenarios. Plans call for three initial mission-specific videos, each one concentrating on a basic aircraft type. The three aircraft types under consideration include a helicopter (e.g., AH-1W), a tanker-transport platform (e.g., MC-130), and a fighter/attack aircraft (e.g., F/A-18D).

Interactive Videodiscs

Floyd (1982, p. 2) in the Handbook of Interactive Video defines interactive video as "any video program in which the sequence and selection of messages is determined by the user's response to the material." Traditionally, video productions are presented in a linear manner. That is, the programs start at the beginning and run straight through continuously until the end. The viewer has no control over the presentation. On the other hand, interactive video is predominantly non-linear. In non-linear video, the video program is typically divided into segments. These segments may be presented in several different orders and randomly accessed. The user determines the order of the video presentation by responding to prompts from the program (Matthewson, 1983). It is the random access attribute of interactive video, and specifically the quick random access capability of videodisc players, that makes interactivity appropriate for some aspects of aircrew training.

An interactive videodisc has been produced as a proof-of-concept demonstration system. This videodisc is entitled "NVG Illusions and Visual Training." It is a self-paced, stand-alone instruction device based on a Macintosh computer interfaced with and controlling a videodisc player. A student is presented with screens of text that provide subject information and also contain prompts that guide the student through the program. When appropriate, the computer commands the videodisc player to display the accompanying audio-video sequence.

As a follow-on to the six NVG training video programs, an interactive videodisc is being produced that will serve as an audio-visual training aid. Numerous examples of NVG imagery pertinent to what is presented in the prototype NVG training course will be on the videodisc. The examples will be arranged under both main and sub-headings. A menu-driven computer program will allow the instructor to randomly access any segment. The computer program will be encoded on the videodisc along with the video and audio information. A computer microprocessor, located within the videodisc player, will enable the interface between the videodisc and the user. The interactive videodisc will be used during lecture portions of the NVG training course. Instructors will be able to discuss a certain aspect of NVG employment and then immediately augment that point with an audio-visual segment from the videodisc. A system similar to this one (dealing with low altitude visual perception subjects) has been used by the Tucson Air National Guard since 1987. Its usefulness is

acknowledged by both the instructors who use it and the students who view it (Thomae C., personal communication, March 6, 1989).

The production of a videodisc that will serve as an NVG audio-visual database is also planned. This videodisc will contain examples of NVG imagery culled from the video library being compiled at AL/HRA. Unlike the lecture aid videodisc described above, this videodisc will not contain any computer programming nor will the segments be arranged by various menus. Such a layout will allow for the videodisc to be configured in several ways by several users. All such configurations will require interfacing the videodisc with an external computer. The purpose of the NVG audio-visual database videodisc is for it to be integrated into existing and future developments of NVG computer-based training (CBT).

An example of NVG CBT that could be augmented with interactive videodisc capability is the courseware being developed by McDonnell Douglas Training Systems at Kirtland AFB in Albuquerque, New Mexico. In its present state, this CBT consists of text and graphics displayed on a computer monitor. The users move through the program at their own pace. An NVG imagery database videodisc could be interfaced to the computer and displayed on the computer's own screen or a separate monitor. Updating this current training program and integrating it with a videodisc would expand the CBT's capability by presenting the student with full motion video and audio information which illustrates the instructional content.

Training Effectiveness Evaluation

Several efforts are being considered to evaluate the effectiveness of all night vision training device modalities. These modalities include didactic and video presentations, computer-based training, terrain board and eye lane instruction, interactive videodisc applications, and simulator instruction. Methods to evaluate the effectiveness of these modalities individually and in various combinations will be addressed in the future.

For more timely feedback on the utility of the initial six programs, an evaluation form has been included as part of the distribution package. Background information is requested including type of aircraft flown, mission, crew position, and total NVG flight time. Questions answered on a Likert scale format ask viewers their opinions on the relevancy of the topics, the clarity of the presentation, whether or not videotape is an appropriate medium for NVG training, and the usefulness of such programs for NVG training. Questions requiring anecdotal responses ask what should be added or changed to facilitate coverage of the present topics and what mission-specific material is best suited for inclusion in future NVG training programs.

Completed evaluation forms are reviewed individually by program producers. The information gathered is used to improve upcoming NVG training presentations. Initial feedback has been extremely positive.

Future programs may require or receive more formal effectiveness evaluations. Such evaluations may be conducted by in-house personnel or they may be contracted out to firms that conduct such research. These evaluations may be

conducted to determine an NVG training program's cost effectiveness, to calculate a program's immediate instructional effectiveness and efficiency, to ascertain a program's impact over the long term, to determine how the program could be improved, and to document the production process (Reeves, 1989).

SUMMARY AND CONCLUSIONS

Video presentations showing examples of NVG imagery can successfully be used to augment NVG training. Video technology allows instructors to illustrate and reinforce concepts, characteristics and techniques in the safety of the classroom. AL/HRA will continue to produce NVG training media in both linear and non-linear formats. Producing linear versions of programs allows users who do not have access to interactive videodisc to obtain the benefits such presentations can provide. Non-linear programming puts state-of-the-art technology into aircrew training, increasing its overall effectiveness.

As production continues on NVG instructional media, AL/HRA hopes to improve the resolution of image-intensified video. An ongoing expansion of a videotape library demonstrating NVG and other night vision device (e.g., forward looking infrared) image characteristics and effects is another long-term goal. Finally, AL/HRA will continue to conduct applied research and development work with regard to multimedia and interactive technologies in an ongoing effort to improve aircrew training.

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